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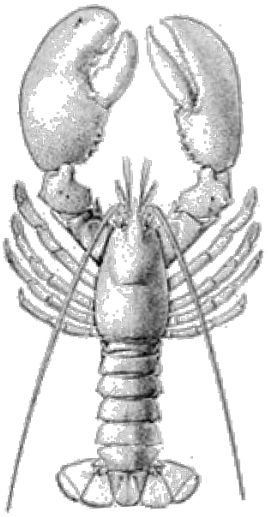
Canadian Science Advisory Secretariat
Quebec Region **Science Advisory Report 2016/043**

2015 LOBSTER STOCKS ASSESSMENT IN THE GASPÉ, QUEBEC AREA (LFAS 19, 20 AND 21)



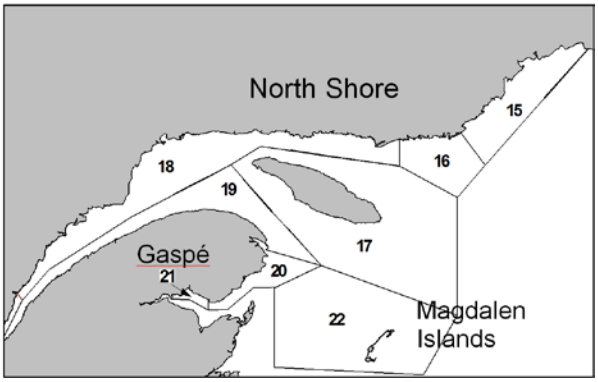


Figure 1. Map showing lobster fishing areas (LFAs) in Quebec (LFAs 15 to 18: North Shore and Anticosti, LFAs 19 to 21: Gaspé and LFA 22: Magdalen Islands).

Context:

One hundred and sixty-eight companies (a captain-owner and one or more fishers' helpers) fish for lobster in the Gaspé. Fishing effort is distributed among three lobster fishing areas (LFAs 19, 20 and 21) (Figure 1) subdivided into 27 subareas (Figure 2). The largest number of companies operate in LFA 20, 88% of the total number in the Gaspé. A small fleet (eight companies) fishes along the north shore of the peninsula (LFA 19) between Forillon and Grande-Vallée. Thirteen companies fish in LFA 21. In the fall, the Listuguj Micmac fish for subsistence in Area 21B. The fishery is managed through fishing effort control measures (number of licences, number and size of traps, fishing season and daily schedule, organization of trap lines) and escapement measures: minimum and maximum legal sizes, release of berried females and release of females with a V-notch on their telson, marked in this way by fishers on a voluntary basis. Management and conservation measures introduced over the past 19 years follow the recommendations of the Fisheries Resource Conservation Council (FRCC). The status of the resource is assessed every three years. This report describes the situation in 2015 and changes observed since the last stock status assessment in 2012.

SUMMARY

- **Landings**, the main abundance indicator, reached an all-time high of 1 802 tonnes in 2015, which is 106% greater than 2011 values, and 98% greater than the average over the last 25 years for similar fishing effort since 2008, and below the 1994–2004 level. In 2015, 87% of Gaspé landings came from Area 20, 7% from Area 21, and 6% from Area 19.
- For the entire Gaspé area, the **catch per unit effort** (CPUE) in weight from commercial sampling rose sharply, reaching an all-time high in 2014–2015. In Area 19, the CPUE increased by 238% from 2011 (0.48 kg/trap) to 2015 (1.61 kg/trap). In Area 20, the CPUE increased by 41.3% from 2011 (0.34 kg/trap) to 2015 (0.48 kg/trap). In Area 21, the CPUE increased by 213% from 2011 (2.04 kg/trap) to 2015 (2.54 kg/trap).

- In Areas 19 and 21, **demographic indicators** showed that the average size of commercial lobsters was large (96.8 mm and 96.3 mm) in 2015 and that it had decreased slightly in Area 19 and was variable in Area 21 but increased overall since 2011. In Area 20, the average size of commercial lobsters changed little since 2008 (≈ 88 mm), apart from a slight 0.8 mm decrease in the size of males between 2014 and 2015. The size structures of commercial lobsters are much wider in Areas 19 and 21 than in Area 20.
- **Fishing pressure indicators** could not be estimated for Areas 19 and 21. In Area 20, exploitation rates were lower between 2011 and 2014 (71.6%) than between 2008 and 2010 (78.8%) but remained very high, at around 74% in 2014.
- **Productivity indicators** were high in Area 20. The abundance of berried females has continued to increase since 2011, and the egg production increase factor compared to the 1994–1996 period was around 3.0x in 2015, as it was in 2011. However, the contribution of multiparous females to egg production has been on a downward trend since 2005. The abundance of prerecruits in area 20 in 2015 remains high, suggesting that landing levels will remain high in the short run. This information is not available for the other areas.
- High abundance, productivity and landings indicate that the Gaspé lobster stock is in good condition and in the healthy zone according to the **precautionary approach**. In recent years, indicators have remained the same or improved based on prevailing environmental conditions and exploitation levels. However, in Area 20, the small average size of commercial lobsters and the high exploitation rate suggest that actions on reducing fishing effort must be pursued.

INTRODUCTION

Biology

American Lobster (*Homarus americanus*) occurs along the Atlantic coast, from Labrador to Cape Hatteras, North Carolina. Adult lobsters prefer rocky substrates where they can find shelter, but can also live on sandy and even muddy bottoms. Commercial concentrations are generally found at depths of less than 35 m. Females reach sexual maturity at around 82 mm carapace length (CL) in the southern part of the Gaspé Peninsula. Size structures of berried females suggest that they reach sexual maturity at a larger size along the north shore. Males reach sexual maturity at a smaller size. Females generally have a two-year reproductive cycle, spawning one year and moulting the next. Females spawning for the first time can produce nearly 8,000 eggs while jumbo females (127 mm CL) can lay up to 35,000 eggs. In addition to being more fertile, some large females can spawn two years in a row before moulting. Once released, the eggs remain attached to the females' swimmerets for 9 to 12 months, until the planktonic larvae hatch the following summer. Spawning and hatching can occur earlier in the season for multiparous females (females spawning for the second time at least) than for primiparous females. It has also been observed that larvae can be larger upon emergence for multiparous females than for primiparous females. The larvae's planktonic phase lasts from 3 to 10 weeks, depending on the temperature of the water. Following metamorphosis, postlarval lobsters (stage IV), which now resemble adult lobsters, drift down from the surface layer to settle on the sea floor. The survival of lobster from their larval stage to their initial benthic stages is impacted by predation as well as hydrodynamic factors that cause advection or retain the larvae near areas that are favourable for benthic settlement. During the first few years of benthic life, until they reach approximately 40 mm, lobsters lead a cryptic existence; i.e. they live hidden in habitat providing many shelters. Lobsters are estimated to reach the minimum catch size (82 mm) at around eight or nine years of age after having moulted approximately 16 times since their benthic settlement.

Description of the fishery

The lobster fishery is managed using fishing effort controls to regulate the number of licences, number and size of traps and the duration of the fishing season. In the Gaspé, the lobster fishery is a spring activity that lasts 69 days in LFAs 20 to 21 and 71 days in LFA 19. In 2015, there were 168 commercial licences in LFAs 19, 20 and 21. In LFA 19, 250 traps are allocated to each licence. In LFAs 20 and 21, allocations range from 235 to 435 traps depending on mergers and licence buybacks. In these LFAs, the maximum length of wire traps is 92 cm, maximum width is 54 cm and maximum height is 39 cm. The maximum length of hybrid traps (wood / other materials) is 87 cm, maximum width is 56 cm and maximum height is 46 cm. In LFA 19, the maximum length of traps is 92 cm, maximum width is 61 cm and maximum height is 50 cm. Escape vents have been mandatory since 1994. The size of the vertical opening was increased from 43 mm to 46 mm in 2004 in response to the increase in minimum catch size. Traps may not be hauled more than once per day.

In 2006, the number of traps per licence was reduced from 250 to 235 in LFAs 20 and 21 and the fishing season was shortened from 71 to 69 days. A number of licence buyback programs and other initiatives have been introduced, and 50 out of a total of 218 licences have been withdrawn since 2003. Buybacks were mainly in areas where yields were low, such as subareas 20B5–B6, where 13 of 29 licences (45%) were withdrawn. In 2015, nominal effort expressed as the number of trap hauls was estimated at 2.38 million for LFA 20, a 21% decrease from the 1994–2005 average (3 million trap hauls).

The minimum landing size (MLS) was 76 mm CL between 1957 and 1996. Starting in 1997, it increased 1–2 mm every 1–2 years for eight years, reaching 82 mm in 2004. In 2006, the MLS in LFA 19 increased from 82 mm to 83 mm. As a result of the increase in MLS, egg production per recruit doubled compared with 1996. Lobster must meet a minimum catch size requirement, and berried females must be released. Fishers cut a v-notch into the telson of berried females, on a voluntary basis. The number of v-notched berried females varies and is not recorded. However, their release is mandatory. In 2008, a maximum catch size of 155 mm CL was implemented in LFA 20. It has been 145 mm CL since 2012.

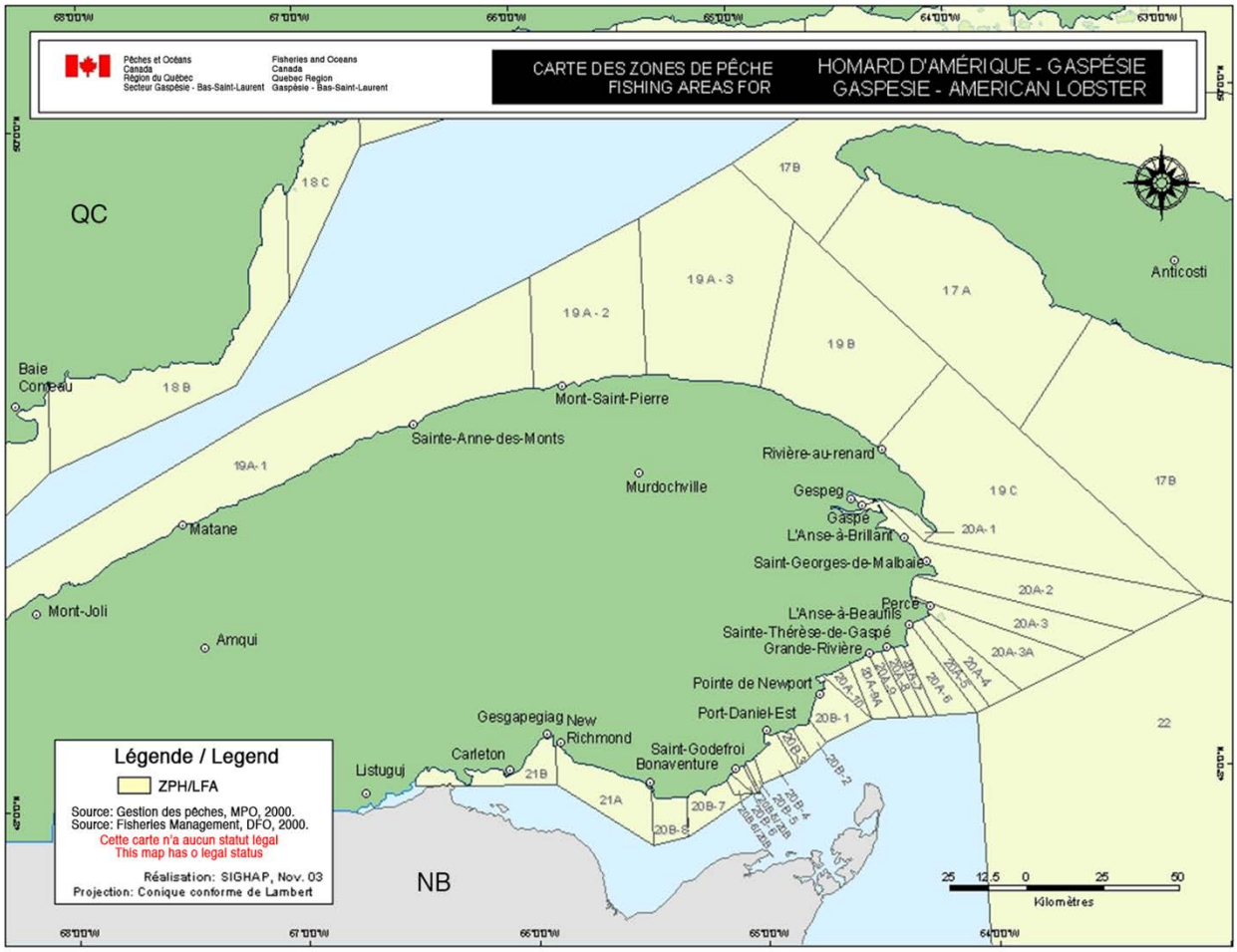


Figure 2. Map of the Gaspé Peninsula showing the different sub-areas of LFA 19 (19A1 to 19C), LFA 20 (20A1 to 20A10 and 20B1 to 20B8) and LFA 21 (21A and 21B).

STOCK STATUS ASSESSMENT

Source of data

The stock status assessment is based on abundance, demographic, fishing pressure and stock productivity indicators. Abundance indicators include landings recorded on processing plant purchase slips and catch rates of commercial-size lobsters obtained mainly from at-sea samplings of commercial catches. Demographic indicators are taken from lobster size structures and include mean size and weight, jumbo abundance and sex ratios. The fishing pressure index (exploitation rate) was determined by calculating the ratio between the number of individuals (males) from the first moult class recruited to the fishery in a given year and the number of individuals from the second moult class recruited to the fishery one year later. Productivity indicators are based on abundance of berried females and egg production (reproduction) as well as abundance of prerecruits (recruitment). At-sea sampling has been conducted aboard fishing vessels since 1986 in La Malbaie (20A2), Ste-Thérèse/Grande-Rivière (20A8–A9) and Shigawake/St-Godefroi (20B5–B6). At-sea sampling was also conducted from 1997 to 2004 in 21B during the spring fishery, from 2002 to 2004 during the fall fishery, and from 2000 to 2004 and in 2011 in 19C. Since 2005, dockside sampling has replaced at-sea sampling in Areas 21B and 19C. From 2008 to 2015, Parks Canada conducted additional sampling at sea in the Forillon National Park area (subareas 19C and 20A1).

Since 2006, 25 to 35 fishers have participated in a fishery recruitment index development project. Participants are allowed to use two lobster traps modified by closing the escape vents and two regular traps placed alternately on a fishing line. They collect data on the number and size (measured with a special gauge) of lobster caught. The abundance of prerecruits is used as a fishery recruitment index one or two years in advance. Project data on commercial-size lobsters and berried females are also considered in the assessment. Since 2011, a postseason (September) survey using modified traps (without escape vents) has been conducted at five sites in the Gaspé (LFA 20) to develop a new fishery recruitment index.

Data from the four previous years are examined for each indicator, and 2015 data are compared to 2011 data and the averages from existing data series prior to 2015.

Abundance indicators

Landings

Landings for the entire Gaspé area reached 1 802 t in 2015 (preliminary data) (Figure 3). They increased by 106.2% compared to 2011 (874 t) and were 97% higher than the 912-tonne average of the last 25 years (1990–2014). In 2015, 87% of total landings in the Gaspé came from LFA 20, 6% from LFA 19 and 7% from LFA 21. Lobster landings from the Gaspé accounted for 30.9% of total landings in Quebec (5880 t). In LFA 20, 2015 landings reached 1 577 t, a 94.9% increase over 2011 (809 t) and 88% over the 839-tonne average of the past 25 years. The upward trend observed since 2011 was noted in the majority of LFA 20 subareas. Keep in mind that landings in LFA 20 had dropped significantly between 2000 and 2005 and did not increase between 2005 and 2009. Landings in LFA 19 totalled 105 t in 2015 (Figure 3). They increased by 276% compared to 2011 (28 t) and were 245% above the 31-tonne average of the last 25 years. Landings in LFA 21A more than doubled between 2011 (49 t) and 2011 (36 t) (Figure 3). In Area 21, landings more than tripled between 2011 (49 t) and 2015 (152 t) (Figure 3) and were 231% higher than the 46-tonne average of the last 25 years.

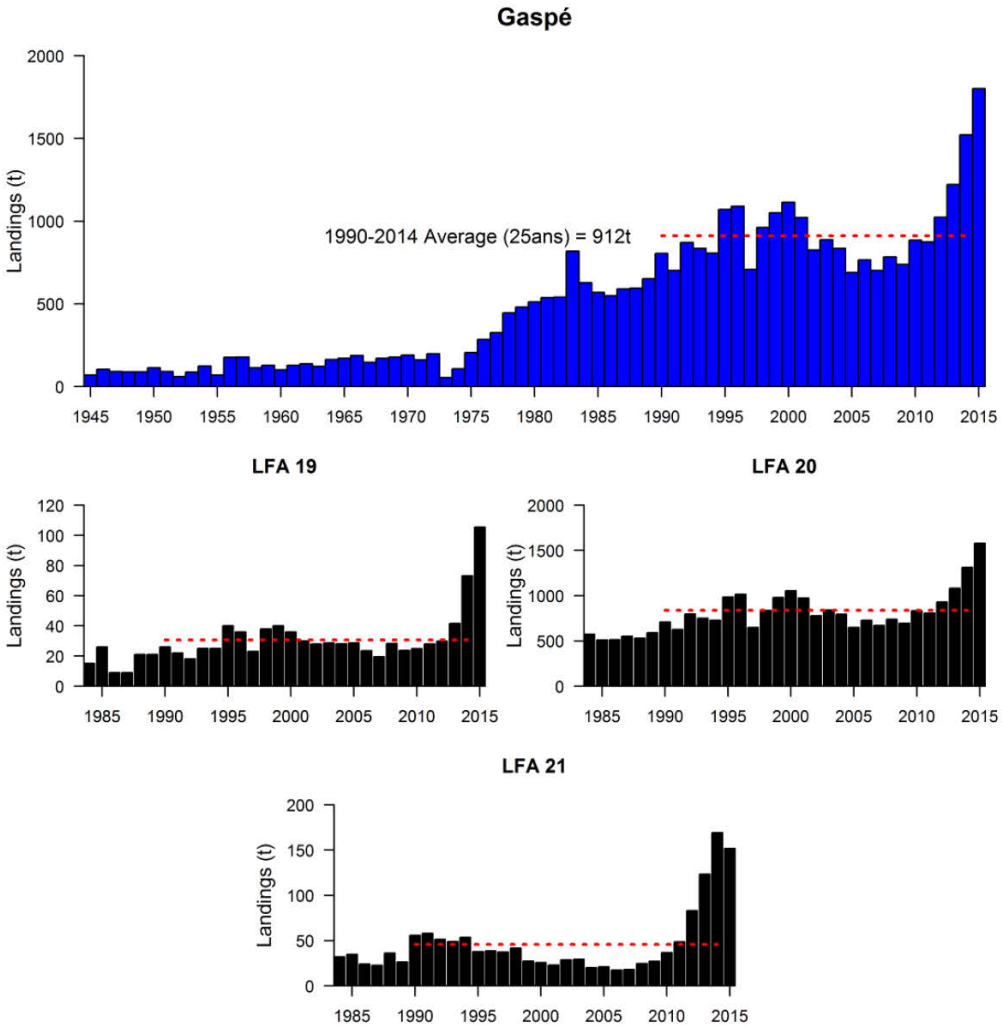


Figure 3. Lobster landings in the Gaspé from 1945 to 2011 and from 1984 to 2011 for LFAs 19, 20 and 21. Dotted lines refer to the average value of the last 25 years.

Commercial lobster catch rates

Catch rates are equal to catches per unit effort (CPUEs) expressed in number or weight of lobster per trap. In 2015, the CPUE for commercial-size lobsters in LFA 20 was 0.82 lobster per trap (no./trap), which works out to 0.48 kg of lobster per trap (kg/trap) (Figures 4A and B). The CPUE in number was 41% higher than in 2011 (0.58 no./trap) and 49% above the average of the last 25 years (0.55 no./trap). The CPUE in weight was 41% higher than in 2011 (0.34 kg/trap) and 64% above the average of the last 25 years (0.29 kg/trap). An increase in CPUEs was observed in the three groups of subareas sampled, especially in 20A2 and 20B5–B6. CPUEs in Area 19 were 2.15 no./trap and 1.61 kg/trap in 2015, a 264% and 235% respective increase over 2011 (0.59 no./trap et 0.48 kg/trap) (Figures 4C and D). The average CPUE measured during the fall fishery in LFA 21B was 2.54 kg/trap (Figure 4E) which represent an increase of 24% compared to 2011 (2.04 kg/trap). This is one of the highest values observed since the start of the fall fishery in 2001. The 2002 to 2013 average (partial data in 2001 and 2014) was 1.43 kg/trap. Traditionally, average CPUEs observed during the spring fishery are always about 0.25 kg/trap.

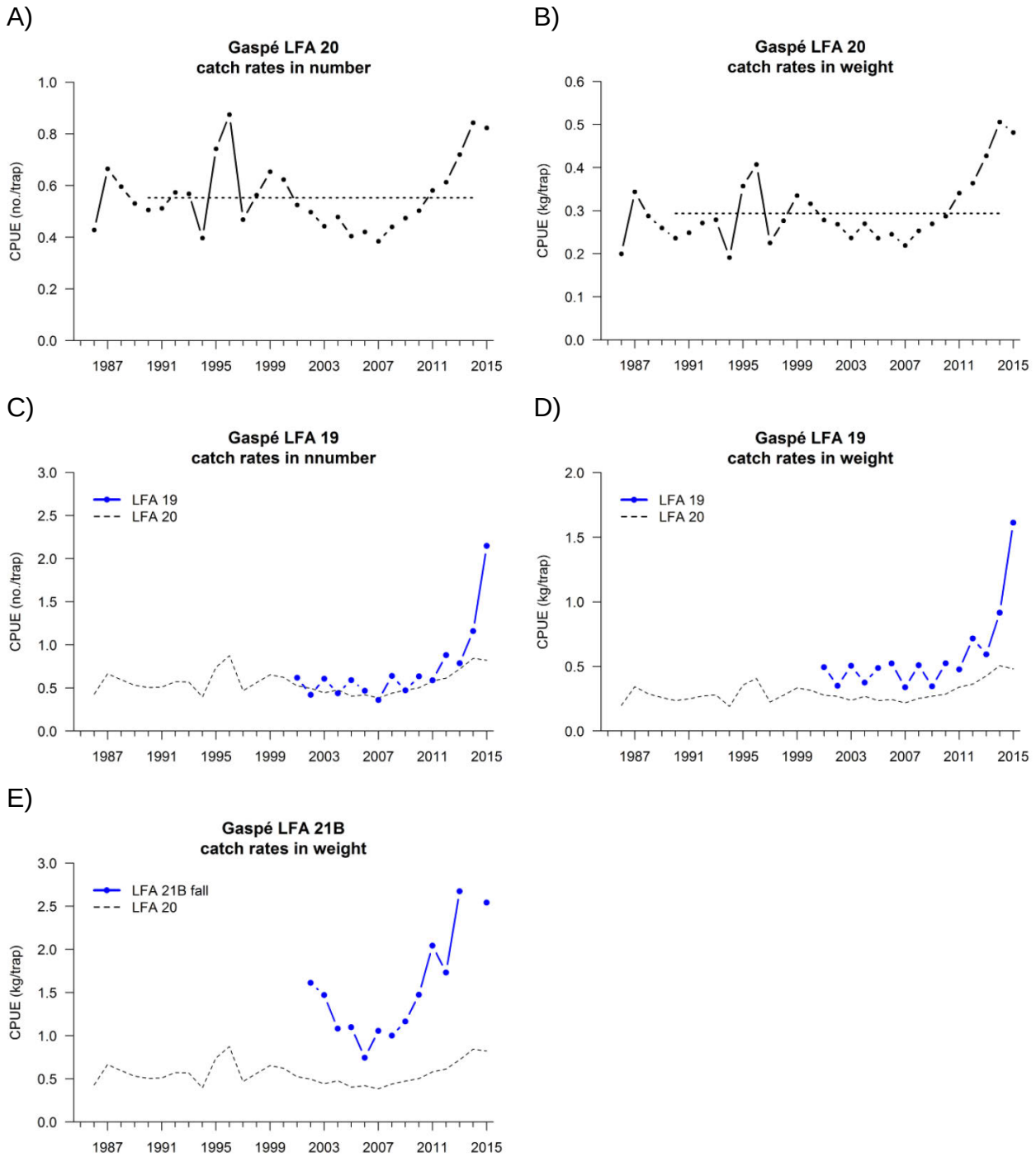


Figure 4. Catch rates (CPUEs) of commercial-size lobsters for LFA 20 in the Gaspé from 1986 to 2015 in number (A) and weight (kg) (B) per trap, for LFA 19C from 2001 to 2015 in number (C) and weight (kg) (D) and for LFA 21B in the fall in weight (kg) (E) per trap. For (A) and (B), the dotted line indicates the average CPUE for the last 25 years excluding 2015. For (C) (D) and (E), the dotted line represents CPUEs from LFA 20.

Demographic indicators

In 2014 and 2015, there were noticeable changes in commercial-size lobster size structures (≥ 82 mm) in LFA 20 (Figure 5A) when significant numbers of recruits entered the fishery. Size structures appear truncated and are dominated by a moult class (82–93 mm for males and 82–89 mm for females) reflecting the year's recruits. Female size distributions are more truncated toward small sizes than male size distributions, reflecting a decrease in the growth of females as they reach sexual maturity. The mean size and weight of landed lobsters has remained stable since 2011 at around 88 mm and 560 g. The proportion of jumbo lobsters observed in at-sea sampling is quite low, fluctuating between 0.2% and 0.3% from 2011 to 2015.

Size structures were more spread out in LFA 19C compared to LFA 20 (Figure 5B). Several moult classes are noticeable. It was also characterized by a much higher percentage of jumbo lobsters. However, there is a downward trend, with jumbo lobsters dropping from 5.2% in 2011 to 2.2% in 2015. The average size and average weight of landed lobsters also decreased from 98.5 mm (786 g) in 2011 to 96.7 mm (744 g) in 2015. The relative decline of jumbos and the decrease in average size is due to an increased number of smaller lobsters (recruits) in the fishery.

The average size of lobsters landed in LFA 21B (dockside sampling) in the spring and fall of 2015 respectively was 101.6 mm and 97.8 mm. Size structures were slightly less truncated than those observed in LFA 20. From 2011 to 2015, the percentage of jumbos fluctuated between 0.6% and 5.5%. The number of lobsters sampled in this LFA remains low, which makes size structures difficult to interpret.

Fishing pressure and sex ratio

Truncated size structures are indicative of high exploitation rates. Exploitation rates calculated for commercial-size males in LFA 20 (cohort monitoring) were variable. For 2011–2014, the average exploitation rate was 71.6%, a 7.2% decrease from the 78.8% rate of 2008–2010. These values were below the 75.5% series average (1986–2013), but remained high with a value of around 74% in 2014.

In general, female mortality was not as high because females are released when berried. As a result, the sex ratio for lobsters left on the sea floor could shift towards females, which is more likely when exploitation rates are high. For the time being, the sex ratio (number of males/number of non-berried females) in LFA 20 seems appropriate to ensure mating (≥ 1).

The situation is different in LFA 19C, where wide size structures indicate that exploitation rates are lower (around 30%). Since 2011, sex ratios have always been greater than one and seem suitable for mating.

Exploitation rates could not be calculated in LFA 21B, but size structures suggested that they were rather high. Sex ratios observed over the past few years were quite often strongly biased towards males (> 2.0).

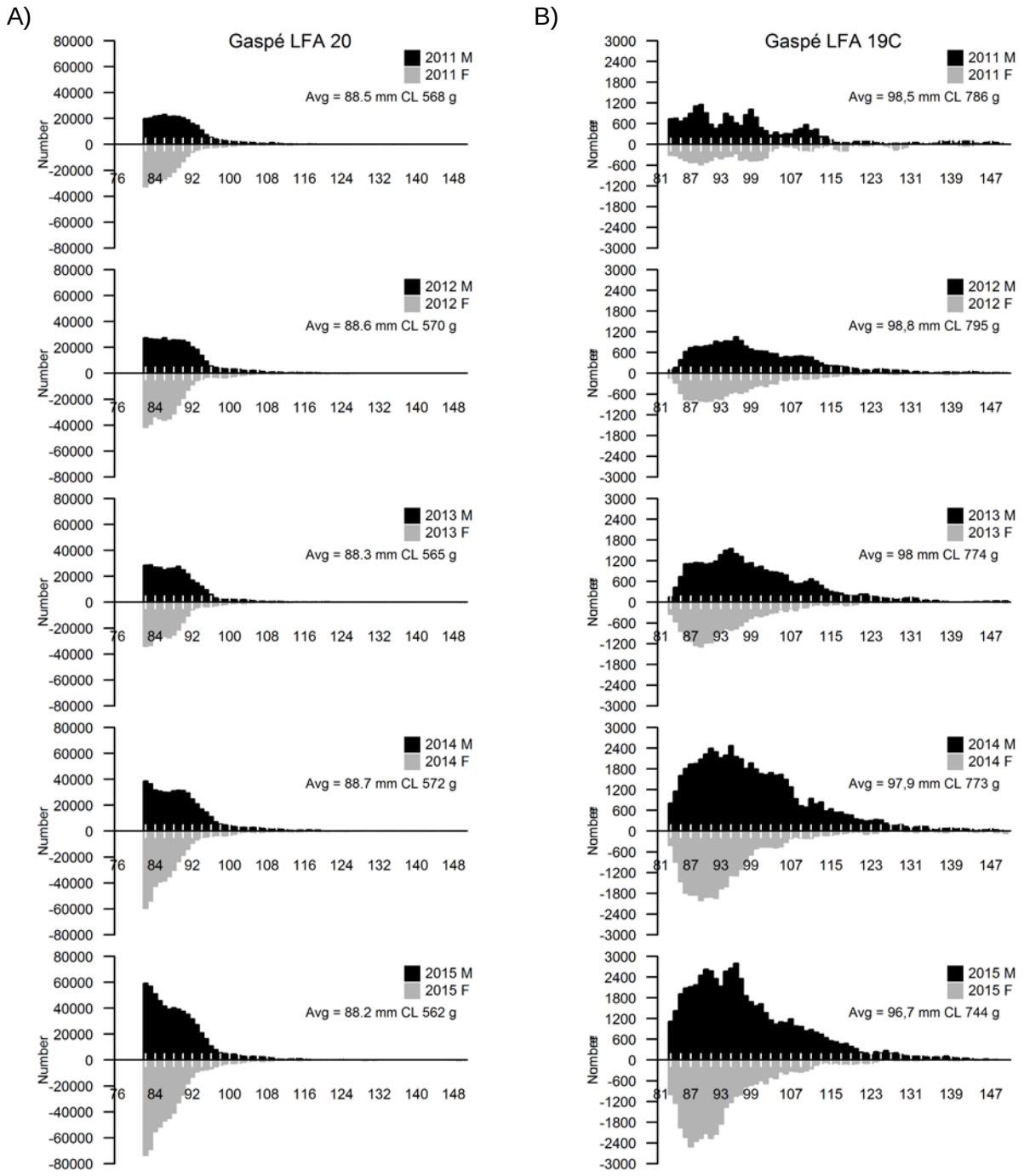


Figure 5. Size frequency distributions of commercial male (black) and female lobsters (grey) in the Gaspé from 2012 to 2015 for (A) LFA 20 and (B) LFA 19. Frequencies are weighted by landings.

Productivity indicators

Berried females and egg production

In 2015, the CPUE for berried females in LFA 20 reached 0.28 no./trap compared to 0.25 nb/trap in 2011. Since 2011, the abundance of berried females has been at least four times

higher than it was when the MLS was 76 mm (Figure 6). The average CPUE from 1986 to 1996 was 0.06 no./trap.

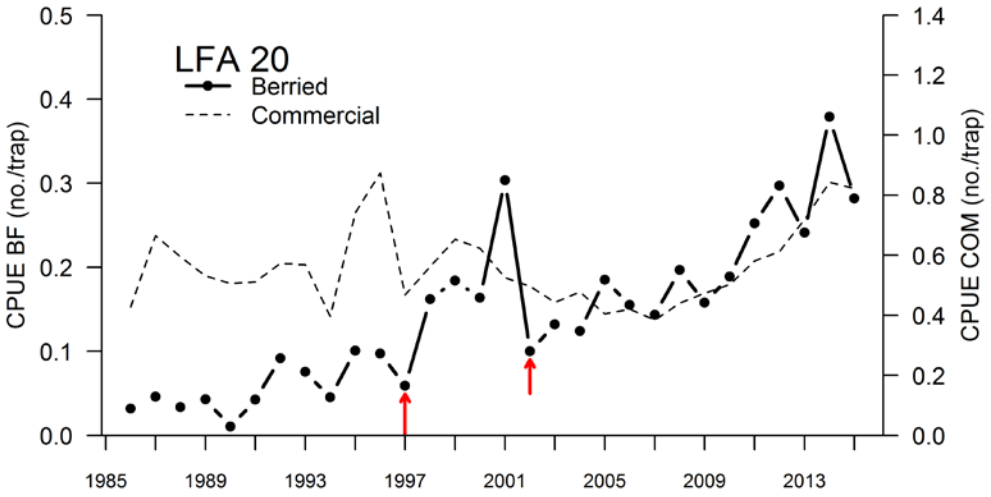


Figure 6. Catch rates (CPUEs) for berried females and commercial size lobsters in LFA 20 from 1986 to 2015. The first arrow indicates the start of the increase in minimum catch size and the second arrow indicates the year when the height of the escape vents was increased from 43 mm to 46 mm.

Size structures of berried females in LFA 20 showed a strong modal value under the MLS (Figure 7). Sixty-eight percent of berried females are below the MLS. Before the MLS was increased, most of these females did not contribute to egg production. In 2015, the average size of berried females was 81 mm CL and multiparous females (those that had already spawned at least once) represented 15% of berried females. An egg production index was calculated by multiplying the abundance index of berried females for each 1-mm size class by the size-specific fecundity. In 2015, the egg production index for all of LFA 20 was 3.4 times higher than that calculated for 1994–1996, prior to the introduction of the increase in the MLS, and multiparous females accounted for 23% of total egg production.

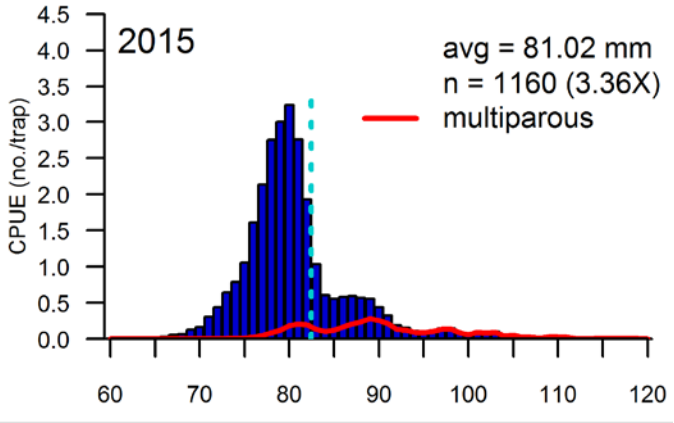


Figure 7. 2015 size frequency distributions of berried females in LFA 20. The red line represents multiparous females. Distributions are weighted by abundance indices (annual CPUEs). The average size and total number of berried females and the rate of increase in egg production compared to the 1994–1996 average (in parentheses) are indicated. The dotted line indicates the MLS.

Recruitment

Abundance indices of prerecruits (70 mm–81 mm, one moult below commercial size) from modified traps (blocked escape vents) used in the postseason survey increased slightly since 2011 in LFA 20 (Figure 8). Generally, there is a positive relationship between the abundance of prerecruits in one year and commercial-size lobsters the following year. However, the relationship can vary between subareas. For LFA 20, the abundance of prerecruits observed in 2015 suggests that landings observed over the past two years could be maintained in 2016 if catchability remains similar. Medium-term forecasts (two years) are still inaccurate because of the short data series. The survey is conducted in the fall after moulting and the population sampled represents individuals available to the fishery the following year. Development of a time series (10 years) should, in the medium term (5 years), enable us to establish a connection between the abundance of prerecruits one year and landings one or two years later.

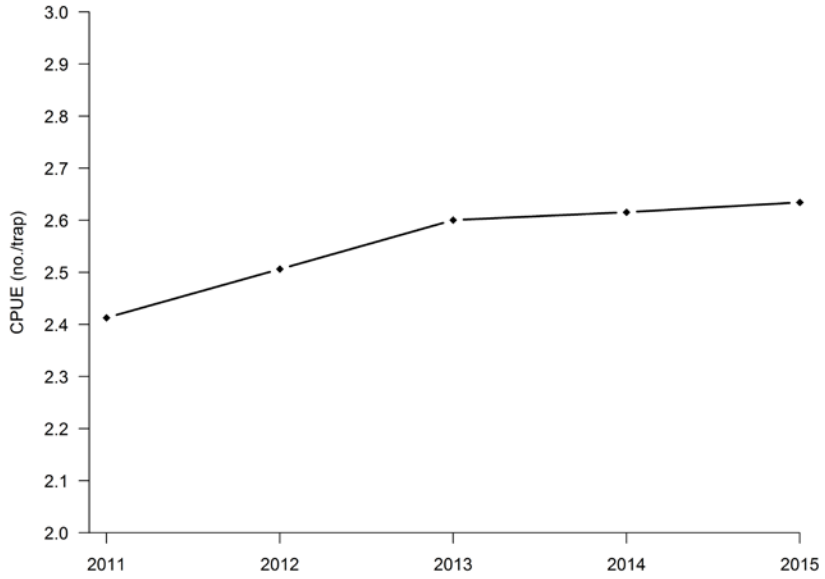


Figure 8. Catch rates (CPUE) for prerecruits 1 (PRE1 = 70–81 mm, one moult below commercial size) from 2011 to 2015 for all of LFA 20. Preliminary data from the postseason survey (blocked vents).

Precautionary approach

A precautionary approach (PA) based on an empirical method was used for the lobster fishery in the Gaspé. The limit and upper reference points (LRP and URP) and the stock status zones (healthy, cautious and critical) were defined from a stock biomass indicator and in compliance with the DFO operational policy framework (DFO 2009). According to the definition in the framework, a stock is considered to be in the critical zone if its biomass is less than or equal to 40% of the biomass corresponding to the maximum sustainable yield (BMSY). The level of 40% of BMSY corresponds to the LRP. The stock is in the healthy zone if its biomass is higher than 80% of BMSY (the level corresponding to the URP). The stock is in the cautious zone if its biomass is between the LRP and the URP. In the absence of estimates of a stock's biomass from an explicit model, the framework states that provisional estimates of BMSY can be used. Since there are no biomass estimates for lobster stocks in the Gaspé, a provisional estimate of B_{MSY} was calculated using landings from a productive period. In this case, landings are considered a reasonably representative indicator of the biomass. As in the case of the Magdalen Islands and the Maritimes, average landings from 1985 to 2009 were used as an approximate B_{MSY}. At least two large cohorts of lobster were produced during these 25 years.

Average landings from 1985 to 2009 were 810 t. The LRP (40% x average) was 325 t and the URP (80% x average) was 650 t. (Figure 9). Based on 3,486 t of landings in 2015, the stock was considered in the healthy zone (Figure 9).

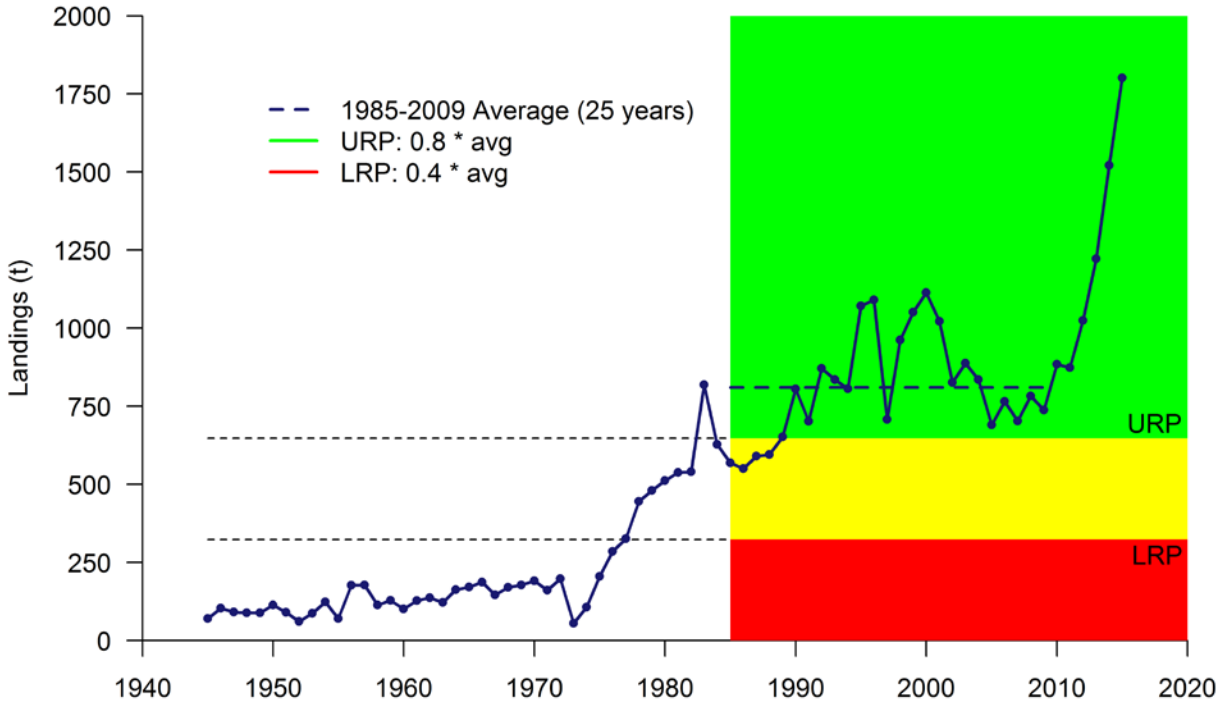


Figure 9. Lobster landings in the Gaspé from 1945 to 2015. Healthy zone is green. Cautious zone is yellow, and the Critical zone is red.

Sources of uncertainty

Coverage of at-sea sampling is low (0.13% of fishing activities), which gives rise to uncertainties in the representativeness of the estimates. Although catch rates (CPUE) are used to reflect lobster abundance on the sea floor, they can be affected by catchability variations that cause uncertainty regarding their interpretation. Changes in catchability can also create uncertainty in the calculation of exploitation rate indices. Spatial fishing patterns can affect the abundance index of berried females if, for example, fishers avoid areas where these females can gather.

CONCLUSION

High abundance, productivity and landings indicate that the Gaspé lobster stock is in good condition and in the healthy zone according to the precautionary approach. In recent years, indicators have remained the same or improved based on prevailing environmental conditions and exploitation levels. However, in Area 20, the small average size of commercial lobsters and the high exploitation rate suggest that reducing fishing effort must be pursued.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 25 and 26, 2016 meeting on the Assessment of Lobster in Quebec Inshore Waters. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

DFO. 2009. A Fishery Decision-Making Framework Incorporating the Precautionary Approach. (consulted on February 20, 2016)

DFO. 2012. Assessment of Lobster Stocks of the Gaspé (LFAs 19, 20 and 21), Quebec in 2011. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/015.

DFO. 2014. Development of reference points in the context of a precautionary approach (PA) for lobster of the Gaspé (LFAs 19, 20 and 21). DFO Can. Sci. Advis. Sec. Sci. Resp. 2013/027.

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